

REMARKS

Claims 1-12 are pending in the present Application.

I. The rejections of claims 1-9 based on 35 U.S.C. § 112.

The USPTO respectfully argues on page 2 of the Office Action that “the specification discloses that an insulating film is formed to a prescribed thickness by forming multiple sublayers and removing impurities between each sublayer formation step.”

In response, applicants respectfully note that the “insulating film” of independent claims 1, 8, and 9 correspond to the “sublayers” respectfully described by the USPTO. Additionally, Applicants respectfully note that claims 1, 8, and 9 have been amended to remove the phrase “a plurality of times” in order to clarify the claims. Overall, it is respectfully noted that claims 1, 8, and 9 relate to forming an insulating film (i.e., the “sublayer” described by the USPTO), and then removing impurities from the insulating film.

Additionally, it is respectfully asserted that independent claims 1, 8, and 9 are clearly enabled by the specification. For example, claim 1 claims in relevant part (claims 8 and 9 claim similar limitations):

“forming an insulating film in a semiconductor device, wherein the insulating film has a thickness in the range of 0.3 to 2 nm; and

removing impurities from the insulating film ~~a plurality of times~~, wherein the removing impurities is performed at a temperature greater than 500°C, to form an insulating film having a prescribed thickness.”

It is respectfully noted that page 8, line 29 through page 9, line 11 of the present specification clearly enable these limitations. For example, page 9 of the present specification describes how a HfAlO_x film having a thickness of 0.5 nm is formed, and then subsequently impurities are removed.

Thus, it is respectfully asserted that independent claims 1, 8, and 9 are enabled by the specification and the § 112 rejections have been respectfully overcome.

II. The obviousness rejections of claims 1 and 8 based on Conley (US 2004/0203254), as noted on page 3 of the Office Action.

The USPTO respectfully rejects claims 1 and 8 under 35 U.S.C. § 102(e) as being anticipated by Conley.

A. Conley does not disclose that the insulating film has a thickness in the range of 0.3 to 2 nm, as claimed in claims 1 and 8.

Claim 1 claims in relevant part:

“forming an insulating film in a semiconductor device, wherein the insulating film has a thickness in the range of 0.3 to 2 nm.” (emphasis added)

Claim 8 similarly claims a range of 0.5 to 2 nm. Regarding these limitations, it is respectfully not seen where Conley discloses the claimed structure quoted above.

For example, the USPTO respectfully argues on page 3 of the Office Action that paragraph [0059] of Conley shows the insulating film has a thickness in the range of 0.3 to 2 nm. However, it is respectfully important to note that paragraph [0059] of Conley states “the deposition of the first and second layers of metal ligand results in a film having a thickness of between less than a monolayer to about 2.5 nm.” Thus, it is respectfully asserted that the thickness of the layers in Conley is not limited to the specifically claimed ranges of claims 1 and 8, which claim a thickness range of 0.3-2 nm and 0.5-2 nm respectively.

Additionally, it is respectfully asserted that the disclosed range in Conley does not disclose the specifically claimed range of claim 1 “with sufficient specificity to constitute anticipation” (see MPEP 2131.03). For example, Conley states at paragraph [0059] that the thickness can be up to 2.5 nm. However, as explained in detail on pages 6-8 of the present specification, Impurities cannot be reliably removed when the thickness exceeds 2.0 nm (see also present Figures 2(A)-4(B)). In other words, limiting the thickness of the insulating film to the specifically claimed ranges of claims 1 and 8 results better removal of impurities.

In contrast, in Conley the impurities may not be reliably removed because Conley discloses using films that are 5 nm thick. For example, based on paragraph [0059] and Figure 2 of Conley, it is respectfully asserted that in Conley a first layer using $Hf(NO_3)_4$ is deposited to 2.5 nm (see step 212 in Figure 2 of Conley) and a second layer using $HfCl_4$ is further deposited to 2.5 nm on the first layer (see step 216 in Figure 2 of Conley). Therefore, there is a total deposition of up to 5 nm in Conley. Thus, it is respectfully asserted that the thickness in

Conley is larger than the specifically claimed numerical range of 0.3 to 2.0 nm (or 0.5 to 2.0 nm) as claimed in claims 1 and 8.

Applicants further respectfully note that the specifically claimed range of claims 1 and 8 relates to the concept of “critical thickness” as noted in paragraph [0057] of Conley (see also step 222 of Figure 2 of Conley). It is respectfully asserted that Conley does not define at all what this “critical thickness” is, and therefore it is respectfully asserted that Conley does not disclose the specifically claimed ranges of claims 1 and 8.

Thus, it is respectfully asserted that Conley does not disclose the specifically claimed range of claim 1 with “sufficient specificity” so as to achieve the advantages inherent in the specifically claimed range of claim 1. Therefore, Conley respectfully does not disclose the specifically claimed thickness range of the insulating film that is claimed in claims 1 and 8.

In contrast, present Figure 6 illustrates one possible embodiment of the claimed structure quoted above. For example, at step 11 of present Figure 6, the insulating film is formed. As explained on page 8, lines 5-10 of the present specification, the thickness of the insulating film is up to 2.0 nm. In other words, the insulating film has a thickness in the range of 0.3 to 2 nm or in the range of 0.5 to 2 nm, as claimed in claims 1 and 8.

Thus, it is respectfully asserted that Conley does not disclose all of the limitations of claims 1 and 8. Therefore, it is respectfully asserted that Conley does not anticipate claims 1 and 8.

III. The obviousness rejections of claims 2-7 and 9 based on Conley in view of Colombo (US 2005/0136690), as noted on page 4 of the Office Action.

The USPTO respectfully rejects claims 2-7 and 9 under 35 U.S.C. § 103(a) as being unpatentable over Conley in view of Colombo. Claim 9 is an independent claim.

A. The cited references do not teach or suggest that the insulating film has a thickness in the range of 0.3 to 2 nm, as claimed in 9.

Claim 9 claims in relevant part:

“forming an insulating film in a semiconductor device, wherein the insulating film has a thickness **in the range of 0.3 to 2 nm.**” **(emphasis added)**

Regarding these limitations, it is respectfully not seen where Conley discloses the claimed structure quoted above.

For example, as respectfully noted above in Section II, Conley does not teach or suggest forming an insulating film with a thickness in the specifically claimed range of 0.3 to 2 nm.

Additionally, it is respectfully asserted that Colombo does not overcome this deficiency in Conley. For example, it is respectfully asserted that Colombo does not teach or suggest anything about the thickness of the insulating film.

Therefore, it is respectfully asserted that the cited references, taken either alone or in combination, do not teach or suggest all of the limitations of independent claim 9. Therefore, it is respectfully asserted that claim 9 is not obvious over the cited references.

B. The dependent claims.

As noted above, it is respectfully asserted that independent claim 1 is allowable, and it is further respectfully asserted that Colombo does not overcome the deficiencies in Conley noted above in Section II regarding independent claim 1. Therefore it is further respectfully asserted that dependent claims 2-7 are also allowable.

IV. The new claims.

Applicants respectfully note that new claims 10-12 have been added. No new matter is added by the amendments. Support for the amendments is found in present Figure 6 and on page 5, line 24 through page 6, line 2 and page 9, line 27 through page 10, line 14 of the present specification.

V. Conclusion.

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable. Accordingly, reconsideration and allowance of all of the claims is respectfully requested.

Please contact the undersigned for any reason. Applicants seek to cooperate with the Examiner, including via telephone if convenient for the Examiner.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130.

Respectfully submitted,

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